AUSTRALIAN EXPERIMENTAL FARMS.

THE importance attached by the various Australian Governments to the encouragement of agriculture is shown in the fact that in most of the colonies a department of agriculture has been established, the official head of which is a member of the colonial ministry. In New South Wales a site suitable for a central establishment was selected at Ham Common, near the town of Richmond, in the Hawkesbury district, about 39 miles from Sydney, where an area of about 4000 acres was resumed for the purpose. The college and farm are now in their seventh year of existence. Accommodation is provided for ninety-six resident students, and during 1898 there was a full roll. Theoretical as well as practical instruction is imparted by experts in every branch of agriculture, and experimental work is carried on with cereal and other crops. There is an orchard, 30 acres in extent, and a vineyard, 10 acres in extent, and the cultivation of plants for the production of scent has also been begun. There are also experimental farms at Bomen, 304 miles from Sydney, in the Murrumbidgee district; and at Wollongbar, 366 miles from Sydney, in the Richmond River district. The former is near the town of Wagga Wagga, and embraces an area of 2460 acres, of which 1200 acres are in cultivation, 1000 acres being devoted to growing cereals, of which 500 acres are for seed wheat; 85 acres to fruit trees and grape-vines, and 80 acres to forage plants; while 8 acres are under olive trees; the remaining portion being taken up by irrigation plots, nursery and experimental plots. Quarters have been provided for twenty-five students. At the Wollongbar Farm experiments have been made with sugar-canes obtained from New Guinea, sugar cultivation being a staple industry on the Clarence, Richmond, and other northern rivers. Experiments with grasses for the grazing of dairy cattle have been carried on, and steps taken to assist the dairying industry, which is greatly on the increase in the northern parts of the colony. Other trials are being made with citrus fruits, pineapples, bananas, and various other tropical and semi-tropical fruits. The total area of the farm is 263 acres. The experimental farm at Bathurst, 145 miles from Sydney, is largely devoted to the cross-breeding of sheep, irrigation, fruit-growing, cereal culture, and general mixed farming. The area of the farm is 596 acres, to which leased areas of 176 acres have been added. The area under cultivation is 370 acres. There are 1000 sheep and lambs on the farm; and nine students have been enrolled. Another farm is situate at Coolabah, in the dry country, about 424 miles from Sydney, where there are about 200 acres in cultivation, trials being systematicatly made with various kinds of wheat, maize, sorghum, cow-peas, grasses, fodders, and so on. There is also a travelling instructor, whose duty it is to visit the rural districts and give personal advice and practical demonstration in all matters connected with agriculture. Under the direction of the Government pathologist, investigations are carried out at the laboratories at the Sydney, Bathurst, and Wagga Wagga farms. At a laboratory at Pymble, a few miles from Sydney, the diseases of citrus plants have formed the subject of special inquiry. Operations at Bathurst are not specially directed to agriculture, but are confined more to the diseases of stock; but at Wagga Wagga the work of the laboratory is mainly in connection with wheat and other farm crops.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A SCHOOL of forestry is to be established at Yale University. The large estate bequeathed by the late Prof. O. C. Marsh will be used as a school of botany, and will also be used for the present as a school of instruction in forestry.

BESIDES the degrees recognised by the State, the universities of France can grant degrees exclusively scientific, but which confer none of the rights or privileges belonging to the State degrees, and which must in no case be declared as equivalent to them. We learn from the *Lancet* that the Nancy faculty of medicine is not content with its power to present candidates for the university doctorate as regards medicine, but desires the right to present for a degree persons who have shown their especial knowledge in biological science. The council of the University of Nancy has agreed to this proposition, and accepted it at a special meeting. The resolution has just been approved by the Minister of Public Instruction, and so, starting during the current scholastic year, the faculty of medicine at Nancy is authorised to present candidates for the new degree, which is the first of the kind to exist in France.

THE unsatisfactory condition of the teaching of geography in this country should afford plenty of scope for the work of the Geographical Association, which aims "to improve the teaching of geography by spreading the knowledge of all such methods as call out the pupil's intelligence and reasoning powers and make geography a real educational discipline, instead of merely loading the memory with names and isolated facts." The membership of the Association has hitherto been limited to teachers in secondary schools and others interested in public school education. At the recent annual meeting, its boundaries were extended, and the Association is now open to all teachers of geography, and to other persons desirous of encouraging improved methods of geographical instruction. Geography as it is usually taught ought to be banished from our schools, for it is of no scientific value whatever, and benumbs a child's intellect instead of developing it. When the authorities which supervise and examine the work done in primary and secondary schools take a wider view of geography than at present exists, when, in fact, they make geography mean physiography, there will be hope for the rational methods of teaching which the Geographical Association seeks to encourage.

A SHORT time ago it was proposed to form a Bureau or School of Research in Washington, under the supervision of the Smithsonian Institution. The Regents of the Institution are in sympathy with the scheme, but they consider that their present powers are scarcely broad enough to embrace the work proposed. They may, however, decide to ask Congress to provide the means for organising the scientific work of the various Government departments, and for co-operating with the universities and colleges of the United States in systematic research work. The Bureau would be in connection with the proposed National University, upon which subject a sub-committee of the National Educational Association has just presented a report. The committee suggests that if the Smithsonian Institution is unable to take the initiative in the matter, the Bureau of Education shall become the administrative centre of the Bureau of Research. Under the terms of either of the plans proposed, it is assumed that the persons admitted to carry on research will be graduates of a college or university in good standing, or will have had an equivalent training. The committee point out that such a bureau of research, whether it be placed under the care of the Smithsonian Institution or under that of the Department of Education—which would supersede the existing Bureau of Education—would be a source of strength to the higher education of the United States and a great advantage to the Government in its work of promoting the progress of science and the useful arts, and in applying the result of scientific investigation to the development of the natural resources of the country, of agriculture, of manufactures, and of commerce.

SCIENTIFIC SERIALS.

American Journal of Science, March.—Hot water and soft glass in their thermodynamic relations, by C. Barus. Glass shares the property of colloids, of being soluble in a liquid when the latter is hot enough. Glass is dissolved in water heated under pressure to 210°. Every glass at a sufficiently high temperature must eventually show complete solubility in water. Such solutions are, however, unstable at ordinary temperatures. The solubility of silicates in very hot water has an important bearing upon natural phenomena. Sea-water more than 200 metres below the surface of the ocean will remain liquid at 200°. If, therefore, water from anywhere below that depth penetrates into the earth as far as the isotherm for 200°, the rock there, if of the character of glass, will become liquefied, apart from pressure. The hydrated silicate is thus virtually fluid 8 kilometres below the surface, and the level of aqueous fusion is five times as near the surface as that of igneous fusion.—An electrical thermostat, by W. Duane and C. A. Lory. The thermostat, which is of very high efficiency, consists of a wooden trough containing an ordinary salt solution, which is heated by an electric light current introduced through zinc plates at the ends of the trough. The regulating device is a set of brass tubes filled with alcohol, whose expansion depresses a thread of mercury in one arm of a U-tube, and thus makes

contact in the other arm. The circuit thus established works a relay which inserts a resistance in the heating circuit, and thus automatically reduces the temperature. The action is remarkably prompt, the regulating circuit being made and broken two or three times per second. The temperature of the thermostat remains constant to within $\frac{1}{2000}$th of a degree C., even when the surrounding temperature changes suddenly by some 12 degrees.—Explorations of the *Albatross* in the Pacific, (iii.), by A. Agassiz. The deepest trawl haul yet made was made about 75 miles east of Tonga-Tabu. It was at 4173 fathoms. The bag brought up a number of large fragments of silicious sponge, belonging probably to the genus Crateromorpha, which had been obtained by the *Challenger* at depths of only 500 fathoms. The bottom consisted of light brown volcanic mud mixed with radiolarians.—Illinois Gulch meteorite, by H. L. Preston. This siderite was found in Montana last year, on the bed rock about four feet below the surface. It weighs 2½ kilograms, and consists of 92 5 per cent. iron, 6·7 per cent. nickel, and traces of cobalt, silicon, phosphorus and carbon. It shows no figures on etching, but greatly resembles the Morrodal siderite of Norway.—The Silurian-Devonian boundary in North America, by H. S. Williams. This first article deals with the Chapman sandstone fauna. It must be regarded as the equivalent of the topmost fauna of the Welsh Silurian system. This classifies the Lower Helderberg formation in the Silurian system.

THE *Physical Review* for January contains the first part of a paper, by Prof. R. A. Fessenden, bearing the title of "A determination of the nature of the electric and magnetic quantities, and of the density and elasticity of the ether."—Mr. B. E. Moore, in the same number, deals with electrolytic polarisation; and Mr. H. V. Carpenter with the comparison of two self-inductances.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 1.—"On the Influence of the Temperature of Liquid Air on Bacteria." By Allan Macfadyen, M D.

The experiments of Dr. Horace T. Brown and Mr. Escombe (*Roy. Soc. Proc.* vol. 62, 1898, p. 160) have shown that no appreciable influence is exerted upon the germinative power of seeds when exposed for 110 hours to the temperature of liquid air (−183° C. to −192° C.). The results were equally negative in the recent experiments of Sir W. Thiselton-Dyer (*ibid.* vol. 65, 1899, p. 361), in which seeds survived exposure for upwards of six hours to the temperature of liquid hydrogen (−250° C. to −252° C.).

The following investigation on the influence of the temperature of liquid air on bacteria was carried out at the suggestion of Sir James Crichton Browne and Prof. Dewar. The necessary facilities were most kindly given at the Royal Institution. The experiments were conducted under the personal supervision of Professor Dewar, and he has asked me to put the results on record, although it must be acknowledged that the essential features of the investigation are due to him.

Ten organisms were used for the experiments, viz.:—*B. typhosus*, *B. coli communis*, *B. diptheriae*, *Spirillum cholerae Asiaticae*, *B. proteus vulgaris*, *B. acidi lactici*, *B. anthracis* (sporing culture), *Staphylococcus pyogenes albeus*, *B. phosphorescens* and *Photobacterium balticum*.

The cultures were simultaneously exposed to the temperature of liquid air for twenty hours (−182° C. to −190° C.). They were then carefully thawed and examined. The results may be briefly stated. In no instance, whether on solid or in liquid media, could any impairment of the vitality of the micro-organisms be detected. The fresh growths obtained from the exposed tubes were normal in every respect, and the functional activities of the bacteria were equally unaffected. The colon bacillus produced its typical effects—such as the curdling of milk, the fermentation of sugar and the production of indol; the *Staphylococcus pyogenes aureus* retained its pigment-producing properties, and the anthrax spores their pathogenic action, on animals. The photogenic bacteria preserved their normal luminous properties. These photogenic properties are intimately connected with the functional activities of the cells. The cells emit light which is apparently produced by a chemical process of intracellular oxidation, and the phenomenon ceases with the cessation of their activity. These organisms therefore furnished a very happy test of the influence of low temperatures on vital phenomena. Their cultures, when cooled down in the liquid air for twenty hours, became non-luminous, but on rethawing the luminosity returned with unimpaired vigour as the cells renewed their activity. Watery emulsions of the photogenic bacteria, on immersion in liquid air for a few minutes, ceased to emit light, but on withdrawal the luminosity reappeared in a very short time. Strips of filter paper soaked in the watery emulsions and brightly luminous were immersed directly in the liquid air with similar results. The sudden cessation and rapid renewal of the photogenic properties of the cells, despite the extreme changes of temperature, was remarkable and striking.

The above experiments show that bacteria may be cooled down to −190 C. for a period of twenty hours without losing any of their vital properties.

Further experiments are in progress with the above-mentioned, and with other micro-organisms exposed to the temperature of liquid air for still longer periods of time, as well as to that of liquid hydrogen. These experiments will form the subject of a future communication.

March 15.—"The Theory of the Double Gamma Function." By E. W. Barnes, B.A., Fellow of Trinity College, Cambridge. Communicated by Prof. A. R. Forsyth, Sc.D, F.R.S.

Physical Society, March 23.—Prof. W. E. Ayrton, F.R.S., Vice-President, in the chair.—A paper on some experiments illustrating syntony was read by Mr. P. E. Shaw. The experiments described in this paper have been devised for the purpose of showing in a lecture-room the principles of magnetic space telegraphy, the distance between the sending and receiving circuits being about fifteen yards. A current flowing in a main circuit was interrupted by a tuning-fork of 100 vibrations per second, and a fraction of the current was passed through the sending coil. The sending coil was placed in series with a coil of adjustable self-induction, and the two coils were shunted with a condenser of variable capacity. By suitable adjustments an oscillation of frequency 400 could be maintained in the sending circuit. The receiving coil was in series with a variable self-induction and a variable capacity, and was tuned to respond to the waves given out by the primary. The current induced in the secondary coil was passed round a light drum fastened to a wire tuned to 400 vibrations per second. The drum was placed in a strong magnetic field, and the electrical oscillations caused mechanical vibrations of the drum. On to the drum was attached one carbon of a microphone, and the induced oscillations were thereby considerably magnified in the microphone circuit. This circuit was also arranged in the same way as the former, and by means of another microphone the vibrations were transferred to another circuit where their intensity was sufficient to actuate the diaphragm of an ordinary telephone receiver to such an extent as to render the sound perfectly audible. Mr. Watson described some experiments which he had shown to illustrate syntony. both by obtaining galvanometer deflections and sparks in the secondary circuit. Dr. Lehfeldt asked how the circuit was tuned when it contained both a variable capacity and a variable self-induction. Mr. Shaw said that the values of the capacity and self-induction were connected with the vibration frequency by a formula given by Dr. Lodge. Starting with a known capacity, the necessary self-induction was calculated and small alterations produced by means of an iron core.—Mr. Shaw then read a paper on an electrical micrometer. In this paper the motion of the centre of a telephone diaphragm was measured by means of a system of levers and a spherometer screw. The screw, which had a pitch of 0·5 mm. and a head divided into 500 parts, pressed against the long arm of an aluminium lever. The short arm of this lever pressed against the long arm of another, and so on through three levers. In this way any motion of the spherometer screw was transmitted to a fine platino-iridium point close to a small platino-iridium disc fastened to the centre of the telephone diaphragm. Since the head of the spherometer could be accurately read to 0·1 of a division by means of a telescope, and since the system of levers minified any motion a hundred-fold, it follows that an accurately observable twist of the spherometer head corresponds to a movement of a millionth of a millimetre or 1 $\mu\mu$ of the fine point. To test the action of the levers, the point was removed and a convex lens substituted. This lens formed one of a system by means of which Newton's rings were produced and